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Fuel poverty is a highly complex social problem that is currently defined in technical and economic terms that prioritise energy performance measures as solutions. Yet considering the wider societal aspects of the condition demonstrates how adopting dynamic risk-based metrics can drive tailored and holistic folk-first outcomes.

The condition of fuel poverty, as understood in the developed world, was first defined by Bradshaw and Hutton in 1983[1] as the inability to afford adequate warmth at home. The definition was refined in seminal work by Prof Brenda Boardman of Oxford University[2] as the inability of a household to obtain adequate energy services for 10% of their income. Definitions of fuel poverty are important because they determine what needs to be measured and reported by statisticians, and these statistics frame policymakers' understanding of the needs of fuel poor householders and consequently influence their proposed solutions (see Table 1). In 2013 England moved from the Boardman definition to a 'low income – high costs' (LHIC) definition (known as the 'Hills Definition')[3], according to which a household is classified as being fuel poor if they have required fuel costs that are above the national median average and, were they to spend that amount, they would be left with a residual income below the official poverty line. It is worth noting that under the LHIC definition it is not actually possible to eliminate the condition as it sets a notional minimum household energy expenditure against the UK's poverty line, which is fixed at 60% of the annual median income. In Scotland, where ~649,000 households (26.5%) were classified as being fuel poor in 2016[4], a new definition that will incorporate a Minimum Income Standards-based metric for income in place of the blunt 10% threshold[5] is due to be published in late 2018.

However these refinements and revisions do not guarantee that the resulting metric will be suitable across the range of conditions to which they will be applied. For instance, research shows that in Scotland the 'energy spend gap' between households in rural and island areas and those in urban areas is greater than official statistics suggest, and that these differences exist independently from assumed influencing factors such as dwelling type, heating type and occupancy[6,7,8]. This discrepancy is a direct result of the use of the underlying assumptions and models used to generate the statistics, and serves to further disadvantage householders in these remote areas, where the costs of living (including energy costs) are higher than for urban areas and where support services are harder to access. Another key metric used by policymakers is the (modelled) Energy Performance Certificate (EPC) rating for assessing household energy efficiency, which is highly susceptible to error, particularly for traditional Scottish buildings and other non-standard types of housing common in the highlands and islands. More broadly, current approaches to fuel poverty metrics serves to frame fixing fuel poverty as largely one of improving household energy efficiency and increasing householders' disposable incomes by reducing energy costs, resulting in an emphasis on delivering 'fabric first' interventions that focus on the physical fabric of the housing unit over more holistic 'folk first' ones that prioritize the people affected, and that are designed with the understanding that fuel poverty can often be both a result of and an influence on other aspects of vulnerability, and cannot be effectively addressed in isolation from these factors. This raises the question of what it is these metrics are really aiming to achieve[9,10].

Static metrics to dynamic systems

In keeping with the country's culture and traditions, the Scottish Government's Community Empowerment and Social Isolation agendas[11,12] emphasise the value of supporting and enabling householders and communities to become more resilient to social, economic and environmental challenges, for example by improving internet access in remote areas and investing public money in supporting the development of community renewable energy projects that generate local employment as well as contributing to its ambitious climate change targets. Thus, we argue, an effective policy or intervention is one which not only serves to lift a household out of fuel poverty but which also serves to increase their resilience to the fuel poverty condition[13]. If the aim is also to build resilience amongst individuals and communities, then it is necessary to move away from using static metrics and thresholds to ones that are dynamic.

For example, assessing income and energy spend under the 10% definition means that the outcome of a successful intervention would be not only that actual energy spend falls below the 10% threshold, but also that the net gains (from increasing household income and/or reducing energy spend) would increase at a higher rate than net losses from increasing energy prices and the household expenditure needed to maintain an acceptable energy use regime.

However, even such dynamic metrics cannot be assessed in isolation, and must instead be integrated with a wider conceptualisation of householder vulnerability to fuel poverty and its impacts. Figure 1 illustrates a number of feedback loops into which the vulnerable may become trapped. For instance, a poor heating regime can result in poor indoor quality (for instance, limited ventilation or damp walls) that may have detrimental impacts on the health of the inhabitants (for instance, from mould growth), which can contribute to poor mental health, and so in turn increases the risk of a poor household heating regime[14].

There are many other complexities which will impact on the causation of, for instance, poor mental health, which could be extraneous to this system view, but which could very easily express their negative impact within these energy use feedbacks. Similarly, a person's poor educational attainment may not have been symptomatic of poor mental and physical health, or inadequate heating, yet, it may express itself within these domains (for example, as poor mental health resulting from not being able to manage debt). As such, simply providing affordable warmth may not change the underlying symptom of poor educational attainment. A dynamic definition of fuel poverty would account for cumulative risks (for instance, chronic health conditions, lack of basic numeracy or language skills) further adjusted for by the strength of the influence.

Toward folk-first solutions

Adopting a complex systems view means it is possible to identify and target householders who may not be fuel poor but are, or have become, particularly vulnerable to it because the nodes in this system are directly measurable risk factors. For example, householders diagnosed with one or more physical or mental health problems that are known to be indicative of living in poor quality housing are consequently at risk for fuel poverty. This recognises that vulnerability to fuel poverty and its impacts can be a temporal condition for which entry into one of the negative feedback loops can result from a number of risk factors arising over a short period of time. One example of this, cited in our research[13], is the case of a householder who quickly became vulnerable and unable to manage energy bills due to a difficult relationship breakdown. Had this client not received rapid, empathetic, and face-to-face support from the council's team of energy advocates she would have been at a high risk of a significant further deterioration in her mental health and wellbeing, and falling into the

negative feedback loop between failing mental capacity and increased stress from falling further into debt. Under a dynamic definition the reporting of these risks as occurring within a short period of time would immediately flag the householder as being at high risk and requiring a fast-tracked, holistic, support intervention.

This example is one of many from the data we are able to access through working with local authorities and other frontline services that illustrate why fabric-first approaches to fuel poverty, which focus on improving a home's energy performance rating, have proven insufficient for understanding and addressing the needs of fuel poor and otherwise vulnerable householders[15]. Furthermore, the example above in which the root cause (the relationship breakdown) triggered a number of risk factors (accumulation of debt and a decline in mental health) in a short space of time illustrates how the person-centric, folk-first approach delivered by the local authority was able to overcome the 'presentation problem' where the root cause(s) of a client's problem may not be the one they are seeking support for [16]. This benefits both the client by enabling them to receive more holistic support, and the council by enabling advocates to deliver a more efficient, but also more empathetic, support service.

From a policy perspective, reducing our definition and measurement of fuel poverty to a technical and economic (or purely economic) condition fails to capture both the highly complex social conditions from which it emerges, and so fails to capture the social and economic value of the indirect benefits (co-benefits) of folk-first approaches to alleviating this social inequality. As academics and practitioners in the field we are of the view that in an energy rich nation it is not acceptable that such a large proportion of households suffer daily the deleterious effects of energy rationing, or that they are forced to manage debts just to maintain a reasonable modern standard of living. We believe we have a duty to continually question our understanding of this modern societal inequality, and the methods and approaches we take to defining, identifying and tackling it.

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Declaration of Competing Interests

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Table 1. Comparison of fuel poverty definitions

Fuel poverty definitions	Scotland (pre-2018 revision)[17]	England (pre -2013), Wales[18] and Northern Ireland[19]	England (post-2013)[3]
Basis of definition			
	Boardman: More than 10% of income spent on energy amenity	Boardman: More than 10% of income spent on energy amenity	Hills: low income – high costs, i.e. a household must have required fuel costs that are above the national median average, and were they to spend that amount, they would be left with a residual income below the official poverty line
Assumed heating and occupancy regimes			
	21°C in living room and 18°C in other rooms for 9 hours in every 24 hours, and 16 hours at weekends	As for Scotland, except Northern Ireland uses 20°C for living rooms	Not modelled
Adjustments applied in modelling			
Elderly and disabled: heating	Increased to 23°C in the living room and 18°C in other occupied rooms	England and Wales as for Scotland, no adjustment for Northern Ireland	Not directly adjusted for
Elderly and disabled: occupancy	Adjusted to 16 hours in every 24 hours at all times	England and Wales as for Scotland, no adjustment for Northern Ireland	Not directly adjusted for
Household size	No adjustment for under-occupancy	Adjustments applied for under-occupancy	Not directly adjusted for
Geography and climate	7 regimes accounting for the more varied climate and geography	Assumes a single standard climatic regime	Heating regime and median energy costs as defined and reported by the English Housing Survey
Treatment of income			
Household income	Highest Income Householder (HIH) and spouse/partner only, other adults or children income not included	Whole household income	Median household income as reported by the English Housing Survey
Council tax deductions	Council tax including water and sewage costs deducted	Council tax deducted but not water or sewage costs	Does not consider other household expenditure

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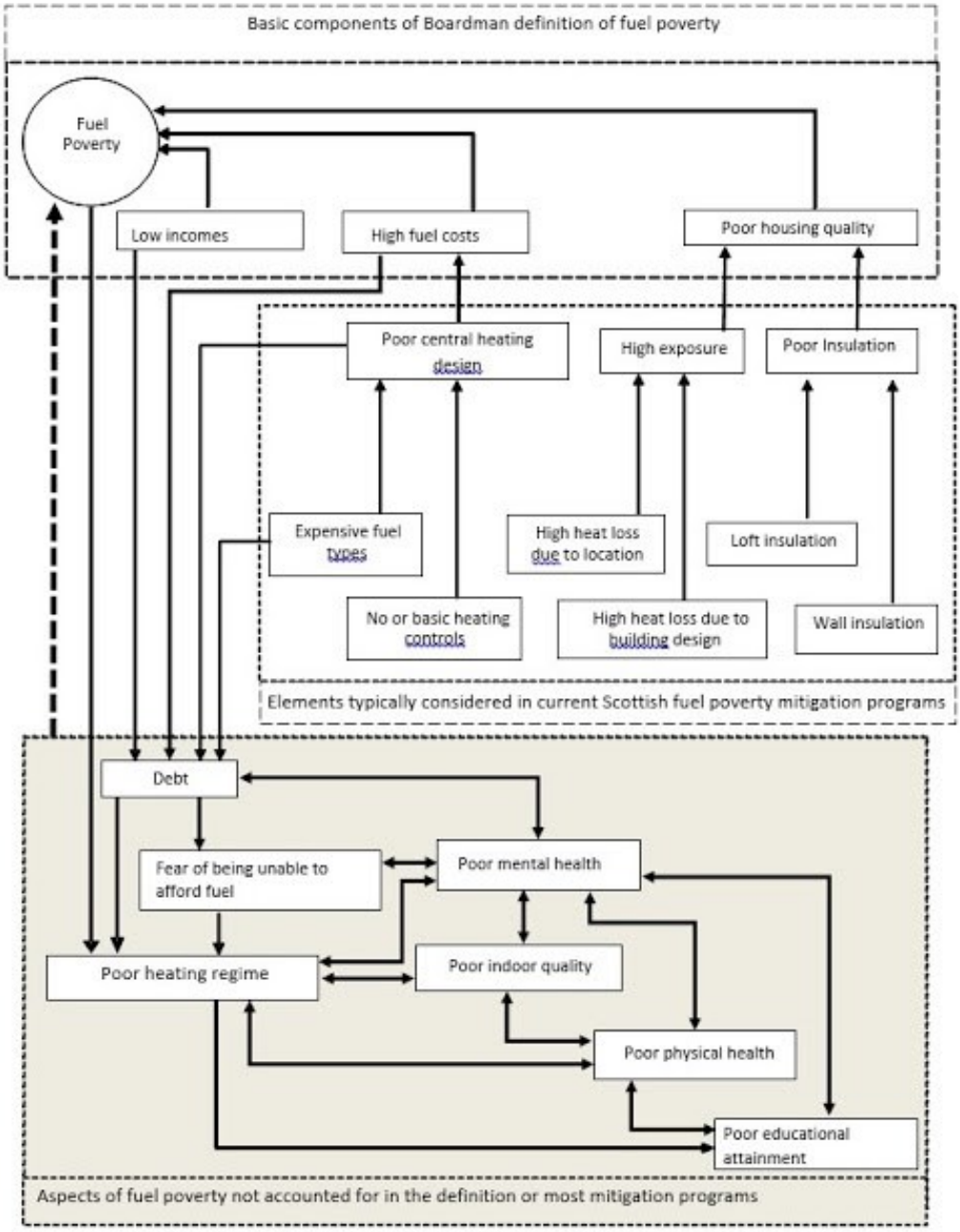

Figure 1. Reconceptualization of fuel poverty

This diagram illustrates our proposed reconceptualisation of fuel poverty, which reconciles the Scottish / Boardman definition with a set of wider social factors that are known to be both influences on and outcomes of the condition. These factors are directly measurable risks, for which data is already collected and reported.

(Note: This is the original version of the figure as published in Mould, R., & Baker, K.J., 2017. Documenting fuel poverty from the householders' perspective. Energy Research and Social Science, 31, (2017), pp.21–31.)